HUMBOLDT'S ESSAY ON PLANT GEOGRAPHY: COMMENTS AND A TRANSLATION

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The term plant geography was introduced by Alexander von Humboldt in his "Essai sur la Geographie des Plantes" in 1805. Humboldt delineated the concerns and outlined the scope of interpretive plant geography as well as historical plant geography. Previous to this essay in 1792, Carl Wildenow, a colleague and friend of Humboldt, began to consider questions regarding the regularity and history of plant distribution in his "Grundriss der Krauterkunde". In 1800, Stromeyer considered plant distribution in relation to the history of man in his "Commentatio inauguralis sistens historiae vegetabilium geographicae specimen." It is, however, Humboldt who is generally credited as the founder of plant geography.

Of the major scientific contributions made by Humboldt during his active career, several are introduced in this essay. His "law of the third dimension" established the similarity of vegetation response to increasing altitude and increasing latitude, and is suggested by several passages in the essay. Humboldt's ascent of Mt. Chimborazo (18,096 feet), the highest known climb by a European for several decades, provided evidence to support this theory. Humboldt offered fifteen major plant physiognomic types in the essay and refined his descriptions in 1806 ("Ideen zu einer Geographie der Pflanzen").

Perhaps Humboldt's major contribution in this and succeeding works was his attempt to associate seemingly unrelated concepts: the biotic community with the physical environment, the physical world with our subjective descriptions (including arts and cultures), and the mechanist with the vitalist theories of life. Such syntheses foreshadowed the later victories of the evolutionist and mechanist hypotheses over the vitalist or religious explanations.

Certain of Humboldt's concerns in this essay have become the foundations of modern disciplines. The two major premises of phytosociology are: (1) plants are commonly found in distinct, recurring, non-random groupings, and (2) such groupings display complex environmental interactions. The goals of phytosociology include the determination of the composition of various groupings and of the types of causative environmental interactions. Such interests were shared by Humboldt early in his academic career; indeed, the major groups practicing phytosociological research in this century may owe much of their impetus to Humboldt. In addition , Humboldt's plant physiognomic descriptions constitute the first modern effort at standardized plant life form categorization. It was almost a century later before Raunkiaer (1934) offered a much improved version. Such categories are informative both about organismal adaptations to the environment and about plant community characteristics.

It is tempting but fruitless to assume that Humboldt intended to support any evolutionary theory in his work. He certainly did not believe that global vegetation distribution is invariable; however, he concurred with his contemporaries (the Neptunists and Cuvier) that natural history helped explain shifting patterns of vegetation. The only mechanisms for species generation advanced by the early 19th century naturalists included either the story of Genesis or the ambiguous "vital force" animating living organisms. It is intriguing to note in defense of Humboldt that botanists have still failed to identify the exact evolutionary history of the world's major cultivated grains, whereas homologies in the zoologic kingdom have been noted for centuries.

The essay was read to the French National Institute on January 7, 1805. It is, as Stearn (1960) writes, "one of the minor classics of botanical literature." The translation into German made by Humboldt was dedicated to Goethe, who shared many of Humboldt's scientific and artistic conerns. Humboldt reported in the preface that as early as 1790, he had "communicated the first sketch of a plant geography ... to Cook's celebrated companion Georges Forster." In 1794 he wrote a friend (Johann Pfaff) that he was engaged in a study which might appear under the title "Ideas on a Future History and Geography of Plants, or, The Historical Report of the Gradual Spread of Vegetation Over the Earth and the General Geological Conditions of the Same" (Meyer-Abich, 1969). Several biographers have either minimized or ignored this essay; however, at least some of the ideas presented here had already intermittently occupied Humboldt's thoughts for fifteen years. As Adolf Meyer-Abich wrote (1969):

> The essay on the geography of plants is without doubt the core of the whole work (Humboldt's Personal Narrative of Travels to the Americas, 1799-1804) as it documents most fully the universal programme behind the whole journey in the field.

Biographical notes:

Of the great naturalists and scientists of the first half of the 19th century--Lyell, Darwin, Wallace, Hooker, Gay-Lussac, Humboldt--the latter is probably least remembered, yet gained the most respect during his lifetime. Humboldt certainly exerted a powerful influence on the careers of the others. He was, by all accounts, generous, kind, responsive, successful in whatever discipline he essayed, prolific and adept in all kinds of scientific research, charming, diplomatic, artistic, and sensitive. He left a lengthy record of almost everything he thought, said, and did.

Alexander and his brother Wilhelm benefitted from private instruction throughout their youth. The Humboldt family was wealthy and enjoyed whatever German culture had to offer in the late 18th century. Both brothers became acquainted with the most advanced thinkers in Europe: Goethe, Schiller, and others. Both went on to renowned academic institutions, Alexander to the University of Gottingen, where he pursued a broad field of studies--physics, anatomy, zoology, and philology; he also met Georges Forster, companion on Cook's expedition to the South Seas. Alexander was almost thirty by the time his five year voyage to the Americas began in 1799, but he had by then made numerous voyages throughout Europe.

While in Central and South America, Humboldt, with his companion Aime Bonpland, rewrote most of the maps, checked magnetic declinations, took air, land, and ocean temperature readings, noted the periodicity of meteor showers and ocean currents, charted the origin and course of tropical storms, computed population sizes, and acquired the largest European collections of South American plants, natural objects and artifacts. Humboldt eventually filled thirty-three volumes with numerous other meteorological, geological, anthropological, sociological, political, demographic, geophysical and biological observations.

Following his return to Europe, Humboldt spent about twenty years, mostly in Paris, writing and compiling information for this monumental account. During this time, he was a favorite of numerous societies, as well as an occasional diplomat of the Prussian court. He was responsible for one of the first successful instances of international scientific cooperation, the establishment of meteorological stations throughout the British colonies and Russia. This developed partly as a result of a nine-month expedition in 1829 led by Humboldt to northern Asia at the invitation of the Czar Nicholas.

Humboldt's most ambitious work, Kosmos, an account of man's knowledge of our physical and organic universe, was not entirely finished at his death in 1859. The publication of Darwin's Origin that year has historically overshadowed Kosmos, however there is no denying the great influence Humboldt's work exerted on a generation of natural scientists.

Humboldt was, first and foremost, a scientific researcher. He sacrificed wealth and home to his travels and publications. He was a specialist in so many fields that he may be remembered, perhaps somewhat unfairly, as a univeralist. Schiller's criticism of Humboldt in 1797 seems now, ironically, to justify Humboldt's work:

> His mind is that cold, dissecting kind that wants all nature to be shamelessly exposed to scrutiny; and with unbelievable impertinence he uses all scientific formulae, which are often nothing but empty words and narrow concepts, as a universal standard.

Humboldt's preface:

Separated from Europe for five years, having travelled through many countries which have never been visited by naturalists, I should have hastened perhaps to publish the abridged report of my tropical voyage and of the series of phenomena which have appeared successively in my investigations. I could have flattered myself that this eagerness would be approved by the public, a portion of which has shown the most generous interest, as much for my personal comments as for the success of my expedition. However, I thought that before speaking of myself and of the obstacles which I had to overcome in the course of my operations, it would be more beneficial to draw the attention of scientists to the grander phenomena which nature offers in the regions through which I travelled. It is the aggregate of such phenomena which I propose to consider here. This essay offers the result of observations which may be found developed in detail in other works which I am preparing for the public.

I include here all physical phenomena observed on the surface of the globe as well as in the surrounding atmosphere. The natural philosopher who discerns the actual state of science, especially meteorology, will not be surprised to see such a large number of objects treated in so few pages. If I could have spent more time editing, my work would only have become still less extensive; for a description should only present vast, sure, physical propositions, capable of expression as precise numbers.

Since my earliest youth I conceived the idea of such a work as this. I communicated the first sketch of a plant geography in 1790 to Cook's celebrated companion Georges Forster, to whom friendship and recognition had closely bound me. My studies made since then in several branches of the physical sciences have helped expland my first ideas. My tropical voyage furnished me with precious illustrations of our globe's physical history. Moreover, it was within sight of those majestic objects of my description, at the foot of Chimborazo, on the coasts of the southern ocean, that I wrote most of this work. I felt constrained to retain the title "Essay on Plant Geography;" any appellation less modest, while better exposing the imperfection of my work, would also render it less worthy of the public's indulgence.

It is primarily for the style that I must ask that indulgence: compelled to express myself for many years in several languages which are no more my own than is the French tongue, I can not dare hope to achieve that purity of style which might be demanded of a work written in my own language.

The description which I shall present today is founded upon observations by myself and Mr. Bonpland. Joined by ties of the most intimate friendship, working together for six years, sharing the suffering to which all travellers are exposed in uncultured countries, we have resolved that all work which is the fruit of our expedition shall carry our two names together.

While reviewing that body of work, the which has been my task since returning from Philadelphia, I have often had recourse to the generous favours of celebrated men. Mr. Laplace, whose name is above my praises, has shown the most flattering interest, as much for the work which I brought back as for that which I believed obliged to deliver following my arrival in Europe. Enlightening and enlivening, so to speak, by the force of his genius all which surrounds him, his good will became as useful to me as it is to those young persons who approach him.

If it is my delight to pay tribute and express my admiration and recognition, friendship obliges me to fulfill duties no less sacred. Mr. Biot honored me with his advice during the editing of this work. Uniting the wisdom of the physician and the profundity of the geometrician, his intercourse became also a fertile source of personal instruction; in spite of his large number of occupations, he consented to calculate the tables of horizontal refraction and light extinction joined to my presentation.

The facts concerning the history of fruit trees were drawn from Mr. Sickler's work, which unites a marvelous erudition with philosophical design.

Mr. de Candolle[1] furnished me with interesting material concerning plant geography in the Hautes Alpes Mr. Ramond imparted similar material on the flora of the Pyrenees; I drew other material from the classical works of Mr. Wildenow. It was important to compare the phenomena of equinoctial vegetation with those presented on our European terrain, Mr. Delambre consented to enrich my description with several measures of elevation never before published. A large number of my barometric observations were calculated by Mr. Prony following the formula devised by Mr. Laplace, in each case with respect to the influence of the force of gravity. This respectable scholar had the kindness to calculate personally more than 400 of my measures of elevation.

I am currently organizing for publication the astronomic observations made in the course of my expedition, some of which were presented to the Bureau of Longitudes to determine their precision. It would be imprudent to publish first either those maps I drew of the continental interior or of my own voyage, since the position of places and their altitude influence all phenomena in the regions through which I journeyed. I am especially tempted to flatter myself that the observations I made of longitude during our navigation of the Orinoco, the Cassiquiare, and the Rio Negro will be of interest to those who are concerned with the geography of South America. In spite of the exact description given by Father Caulin of the Cassiquiare, the most modern geographers have thrown new doubts on the existence of an association between the Orinoco and the Amazon Rivers. Working in that area, I should not have expected to be so bitterly reproached after finding the directions of rivers and mountains very different from those indicated on La Cruz' map; but it is the travellers' fate to displease when they observe facts contrary to admitted opinions.

After the publication of the volume on astronomy, that of my other works will follow rapidly; and it will only be after publishing the fruit of my last voyage that I will busy myself with a new enterprise I have contemplated which may throw light on meteorology and magnetic phenomena.

I can not publish this essay, first fruit of my researches, without offering the homage of my profound and respectful acknowledgement to that government which has honored me with its most generous protection throughout the course of my travels: enjoying a permission never before accorded, living for five years in the midst of a candid and loyal nation, I have known no other obstacles in the Spanish colonies than those presented by physical nature. The memory of such kindness on the part of the government will stay as perpetually graven in my soul as are the marks of affection and interest with which all classes of residents honored me during my sojourn in the two Americas.

Essay on plant georgraphy[2]:

Botanists generally focus their research on objects which comprise only a small part of their science. They are engaged almost exclusively in the discovery of new plant species, in the study of their external structure, of their distinguishing characteristics, and of the analogies which unite them in class and family.

This knowledge of the forms in which organisms are ordered is doubtless the principal foundation of descriptive natural history. One must consider such a foundation indispensable to the advance of those sciences which deal with the medical properties of plants, of their cultivation, or of their artistic merits; but if that foundation is worthy of employing large numbers of botanists, if likewise it lends itself to philosophic endeavors, it is then, no less important to establish a plant geography, a science still in name only, but one which, nevertheless is an essential part of natural philosophy.

It is such a science which examines plants with respect to their native distribution in various climates. As vast as the object of its study, it paints with sweeping strokes the enormous realm of plants, from the land of perpetual snow to the bottom of the ocean, including the interior of our world, where in dark grottoes grow cryptogams as little known as the insects they support.

The upper limit of plants is variable, like that of the perpetual ice, depending upon their distance to the pole or the angle of the sun's rays. We don't know the lower limit of plants; but accurate observations of subterranean vegetation in the two hemispheres prove that our globe's interior is animated wherever organic germs have found the right environment to develop and the nourishment appropriate to their organization. Those rocky, icy summits that our eye barely discerns above the clouds are covered only by mosses and lichens. Analogous cryptogams, now withered, now colorful, branch out on the vaults of mines and underground grottoes. Thus at the two opposite limits to vegetation organisms of similar structure and equally unknown physiology are produced.

Plant geography does not just array plants according to the zones and various altitudes in which they are found; it is not sufficient to consider plants in relation to the conditions of atmospheric pressures, temperature, humidity and electric tension within which they live; one discerns among plants, as among animals, two classes which have a different way of life and, if one dares say it, habits.

Some are isolated and sparsely distributed: in Europe, such are the Solanum dulcamara, Lychnis dioica, Polygonum bistorta, Anthericum liliago, Cratoegus aria[3], Weissia paludosa, Polytrichum piliferum, Fucus saccharinus, Clavaria pistillaris, Agaricus procerus; in the tropics, Theophrasta americana, Lysianthus longiifolius[4], cinchona, Hevea. Other plants gathered in communities like ants and bees, cover immense areas from which heterogenous species are excluded: such are the strawberry (Fragaria vesca), whortleberry (Vaccinium myrtillus), Polygonum aviculare, Cyperus fuscus, Aira canescens[5], Pinus sylvestris, Sesuvium portulacastrum, Rhizophora mangle, Croton argenteum[6], Convolvulus brasiliensis[7] Brathys juniperina[8], Escallonia myrtilloides, Bromelia karatas[9], Sphagnum palustre, Polytrichum commune, Fucus natans, Sphaeria digitata, Lichen haematomma, Cladonia pashalis, and Thelephora hirsuta.

Those social plants are more common in temperate rather than in tropical zones, where less uniform vegetation is no less picturesque. From the banks of the Orinoco as far as those of the Amazon and the Ucayali over an expanse of more than 500 leagues, the entire soil surface is covered by thick forests, and if the rivers did not interrupt its continuity, monkeys, the nearly solitary inhabitants of those widernesses, could, by springing from branch to branch, travel from the boreal hemisphere to the austral hemisphere. But those immense forests do not present the uniform picture of social plants; each sector of forest produces different forms of plants, Here one finds mimosas, Psychotria or Melastoma, there laurels, Cesalpinia, Ficus, Carolinea[10], and Hevea, which entwine their boughs; not one plant has dominion over the others. It is not the same in that tropical region which borders New Mexico[11] and Canada. From the 17th to the 22nd degree of latitude, all of Anahuac[12], the entire plateau from 1500 to 3000 meters above sea level, is covered with oaks and a species of evergreen resembling Pinus strobus. On the eastern slope of the Andes in the Jalapa valleys, one finds a vast liquidamber forest; soil, vegetation and climate there assume the character of temperate regions. This circumstance is observed nowhere else at an equal altitude in South America.

The cause of this phenomenon seems to depend on the structure of the American continent. This continent widens towards the north pole and protracts more in this direction than Europe, which renders the Mexican climate colder than it should be due to its latitude and its elevation above sea level. The vegetation of Canada and the more northern regions spreads toward the south, and the Mexican volcanoes are covered by the same evergreens which seemed to belong only to the sources of the Gila and the Missouri Rivers.

In Europe, on the contrary, the great cataclysm which opened the straits of Gibraltar and dug the Mediterranean's bed prevented the spread of any more African plant species to southern Europe, and so one finds few African plant species north of the Pyrenees. But the oaks which crown the heights of the Tenochtitlan valley are of the same species as those of the 45th degree latitude, and the painter travelling through that part of those countries situated in the tropics in order to study the aspect of the vegetation, would not be struck by the beauty and the variety of form characteristic of equinoctial plants. He would find at the Jamaican parallel, forests of oak, of fir, of Cupressus disticha[13] and Arbutus madronno[14], forests which present all the character and monotony of the social plants of Canada, Europe, and northern Asia.

It would be interesting to designate on botanic maps the lands where assemblages of plants of the same species are found. They would appear as long belts, of which the irresistible extension lessens national populations, separates neighboring states, and places obstacles to their communication and commerce stronger than mountains and oceans. Heather, those associations of Erica vulgaris[15], Erica tetralix, Lichen icmadophila[16], and Haematomma, spreads from the extreme northern tip of Jutland, by Holstein and Lunebourg, to the 52nd degree latitude. From there, they extend to the west, over the granitic gravels of Munster and Breda, to the shores of the ocean.

Those plants, after many centuries, spread soil sterility and reign absolutely over these regions; man, in spite of his efforts, struggles against indomitable nature, and has removed but little land for cultivation. Those ploughed fields, those industrial conquests, the solitary blessings for humanity, form, so to speak, small islands in the middle of the heath lands. They recall to the voyager's imagination those oases of Libya, where the ever fresh foliage contrasts with the desert sands.

A moss common to tropical and European marshes, Sphagnum palustre, formerly covered a large part of Germany. It is that moss which rendered vast terrains uninhabitable to the nomadic peoples whose morals Tacitus described. One geologic fact supports this phenomenon. The oldest turf-pits, where sea salt and sea shells are mingled, owe their origin to ulvas and Fucus; the newest, on the contrary, and the most widespread, spring from Sphagnum and from Mnium serpillifolium, and their existence proves how much those cryptogams teemed over the globe of old. By felling the forests, rural peoples diminished the humidity of the climates; the marshes dried up, and by degrees, useful plants gained the plains occupied exclusively by those cryptogams adverse to cultivation.

Although the phenomenon of social plants seems to belong principally to the temperate zones, the tropics offer several such examples. On the back of the long range of the Andes, at 3000 meters elevations, extend Brathis juniperina[8], Jarava[17] (a genus related to Papporophorum), Escallonia myrtilloides, several species of Molina[18], and especially Tourrettia[19], the nourishing marrow over which native Indians occasionally dispute with bears. In the plains separating the Amazon and the Chinchipe Rivers, one finds together Croton argenteum[6], Bougainvillea and Godoya, as in the Orinoco savannahs, the Mauritia palm, some sensitive herbs and some Kyllingia. In the realm of Colombia, Bambusa and Heliconia offer uniform belts uninterrupted by other species; but those plant associations of the same species are consistently less extensive and less numerous in the tropics than in temperate climates.

To decide as to the existence historically of a connection between neighboring continents, geology bases itself on the analogous structures of coastlines, of ocean shallows, and on the similarity of animals living there. Plant geography furnishes most important materials for this kind of research. It can, up to a certain point, determine the islands which, formerly united, have become separated from one another; it declares that the separation of Africa and South America occurred before the development of living organisms. It is again this science that shows which plants are common to both eastern Asia and the coastlands of Mexico and California, and whether there are some which grow in all zones and at all altitudes. By the aid of plant geography we can go back with some certainty to the initial physical state of the globe. It is this science which can decide whether, after the recession of those waters to whose abundance and movements the calcareous rocks attest, the entire surface of the earth was covered simultaneously with diverse vegetation, or whether, according to traditions of various peoples, the globe, having regained its repose, first produced plants only in a single region, from which ocean currents carried them progressively, during the course of centuries, into the most distant zones.

It is this science which examines whether, across the immense variety of plant forms, we can recognize some primitive forms, and whether species diversity should be considered the effect of a constant degeneration of those varieties originally accidental.

If I could venture some general conclusions from what I have observed in the two hemispheres, I would remark that only the germs of cryptogams seem to have developed spontaneously and naturally in all climates. Dicranum scoparium, Polytrichum commune, Verrucaria sanguinea[20], Verrucaria limitata[21] of Scopoli, appear at all latitudes, in Europe as at the equator, not just on the highest mountain ranges, but even at sea level, wherever one finds shade and humidity.

On the banks of the Magdalena between Honda and Egyptiaca in a plain where the thermometer maintains an almost constant temperature of 28 to 30 degrees C., just below the Macrocnemum and Ochroma, the mosses form a lawn as beautiful and as green as any in Norway. Other travellers have asserted that tropical cryptogams are very rare; there is little doubt those travellers visited only arid shores or cultivated islands without adequately penetrating the continental interior. Lichens of the same species are found at all latitudes; their form seems to be as independent of climatic influence as it is of the rocks on which they live.

We do not yet know of any phanerogram whose organs are flexible enough to accomodate all zones and altitudes. It was futile to claim such an advantage for Alsine media[22], Fragaria vesca, and Solanum nigrum, which advantage seems to be reserved to man and certain mammals in his entourage. The American and Canadian strawberry differs from the European strawberry. Monsieur Bonpland and myself believed to have discovered several roots of the latter species in the Andes by way of the Magdalena and Cauca valleys through the snows of Quindiu. The seclusion of those forests, composed of styrax, of tree-like Passiflora and of wax palms, the lack of cultivation in the environs and other circumstances, seem to exclude the suspicion that those strawberries were disseminated either by man or birds; though perhaps, if we had seen that plant in flower we would have found it specifically different from Fragaria vesca, as Fragaria elatior differs from Fragaria Virginiana by very subtle nuances. At any rate, during the five years spent herborising in the two hemispheres, we collected not one European plant spontaneously produced by the soil of South America. One is forced to believe that Alsine media, Solanum nigrum, Sonchus oleraceus, Apium graveolens, and Portulaca oleracea, are plants which, like the poeple of the Caucasian races, are well distributed in the northern part of the old continent. We still know so little of the productions of the earth's interior that we should refrain from all general conclusions, otherwise we risk falling into the geologists' error of constructing the entire world after the model of the nearest surrounding hills.

To settle the question of plant migration, plant geography descends to the interior of the globe; there it consults ancient monuments that nature has left in the form of petrifactions in the fossil wood and coal beds, which are the graves of our planet's first vegetation. The science of plant geography discovers pertrified fruits from the Indies, palm trees, tree ferns, members of the banana family, and tropical bamboos buried in the frozen earth of the North. Plant geography considers whether that equatorial yield, like the bones of elephants, tapirs, crocodiles and marsupials recently found in Europe, could have been carried by currents in a submerged world to temperate climates, or whether those same climates formerly sustained palm trees and tapirs, crocodiles and bamboo. The latter appears more reasonable if one considers local conditions associated with petrifactions in the Indies. But can we grant such great changes in atmospheric temperature without resorting to a displacement of the stars or a change in the earth's axis, which the current state of our learning in astronomy indicates is unlikely? If the most striking geologic phenomena bear witness that out planet's crust was formerly liquid, if stratification and the differences in rocks indicate that mountain formation and crystallization of great masses around a common nucleus were not effected simultaneously over the earth, it is possible that the change from a liquid to a solid state released large quantities of heat, thus temporarily increasing regional temperature independently of the sun. But could that local increase have lasted long enough to account for the observed phenomena?

Observed changes in starlight have led to the surmise that the central star of our system undergoes analogous variations. Could an increase in the intensity of sunbeams in certain eras cause tropical heat to spread to zones adjoining the pole? Are the variations which make Lapland habitable to equatorial plants, elephants and tapirs periodic, or are they the effect of some transitory disturbances in our planetary system?

Such are the discussions which unite plant geography and geology. By shedding light on the ancient history of our globe plant geography offers to man's imagination a field as rich as it is interesting to cultivate.

Plants, although quite analogous to animals in their response to stimuli and in the irritability of their fibers, differ essentially with regard to their mobility. Most animals leave their mothers only as adults. Plants, however, are fixed to the soil after their development, and can migrate only as eggs, the structure of which favors mobility. But it is not just the winds, currents, and birds which assist plant migrations; it is above all, man.

As soon as man gives up the wandering life, he surrounds himself with useful plants and animals capable of clothing and feeding him. This transition from a nomadic life to agriculture occurs slowly with the Northern peoples. In the equatorial regions between the Orinoco and the Amazon Rivers, the thickness of the woods prevents the savage from being a hunter: he is forced to care for certain plants, a few roots, including jatropha, bananas and Solanum, which sustain him. South American Indians are sustained principally by fishing, the friut of the palm trees, and those small cultivated fields (if I may be allowed to speak of cultivation where there is such a small variety of crops). Everywhere the savage's life is subdued by the nature of the climate and the soil where he lives. Those modifications alone distinguish the first Greeks from the Bedouin shepherds, and them from the Canadian Indians.

Some plants, subjected to cultivation and gardening from the earliest days, have followed man from one end of the globe to the other. Thus, in Europe, has the vine followed the Greeks, wheat the Romans, and cotton the Arabs. In America, the Toltecs carried corn with them; potatoes and green quinoa are found wherever the inhabitants of ancient Condinamarca[23] passed. Migration of those plants is evident, but their native home is as little known as that of the different races of man, which we find already spread over the entire globe in the remotest past. To the southeast of the Caspian Sea, on the banks of the Amu-Darya, in ancient Colchis, and especially in the province of Kurdistan, where the highest mountains are perpetually covered with snow and are consequently higher than 3000 meters, the earth is covered with lemon trees, pomegranate trees, cherry trees, pear trees, and all other fruit trees gathered in our gardens. We do not know if that is their native locality or if, cultivated formerly, they became wild, and attest by their presence to the historic cultivation of these regions. The fertile lands between the Euphrates and the Indus Rivers, between the Caspian Sea, the Black Sea and the Persian Gulf, furnished a most precious yield to Europe. Persia gave us the walnut and peach trees; Armenia, the apricot tree; Asia minor, the cherry and chestnut trees; Syria, the fig, pear, pomegranate, olive, plum, and mulberry trees. While Cato ruled, Rome still was not acquainted with cherries, peaches, or mulberries.

Even Hesiod and Homer mention olive cultivation in Greece and the islands of the archipelago. Under the reign of Tarquin, that tree was still unknown in Italy, Spain, and Africa. Under the consul Appius Claudius, olive oil was still quite rare in Rome; but by the time of Pliny, the olive tree had already spread to

France and Spain. The grape vine that we cultivate today is not native to Europe; it grows wild on the coasts of the Caspian Sea, in Armenia and Caramania[24]. From Asia it passed to Greece, and from there to Sicily. The Phocaeans brought it to southern France; Romans planted it on the banks of the Rhine. The species of Vites growing wild in North America, and which gave the name Wineland to the first part of the continent discovered by Europeans, are quite different from out Vitis.

A cherry tree loaded with fruits adorned the triumph of Lucullus; it was the first tree of its species to be found in Italy. The dictator had removed it from the province of Pont following his victory over Mithridates. In less than one century the cherry tree was already common in France, Germany, and England. Thus does man change the surface of the globe to suit his pleasure, and assembles around himself plants native to climates far removed. European colonies in the two Indias exhibit small cultivated plots of Arabian coffee, Chinese sugar cane, African indigo, and a multitude of other plants from both hemispheres. Such a variety of cultivated plants is even more interesting when one considers the course of events which spread the human race over the entire surface of the globe, from which our race has adapted our entire agricultural harvest.

In this manner, an industrious and restless race, roaming over the diverse parts of the world, forced a certain number of plants to inhabit all climates and elevations. However, this control exercised over organized beings has not altered their primitive structure. The potato, cultivated in Chile at an elevation of 600 meters, bears the same flower as the one introduced on the Siberian plains. The barley which nourished Achilles' horses was doubtless the same that we see today. The characteristic forms of plants and animals currently present on the surface of our globe do not seem to have undergone any change since the most remote times. The ibis hidden undergrown in the Egyptian catacombs, that bird whose antiquity dates nearly to the Pyramids, is identical with the bird that fishes today on the banks of the Nile. This identity evidently proves that the enormous deposits of animal fossils enclosed in the heart of the earth do not come from present species, but from an order of the physical world far different from our own, and too ancient for our traditions to enlighten.

Man, favoring by cultivation those plants recently introduced, has helped subjugate native species; but this preponderance, which renders the vista of the European horizon so monotonous, and which so discourages touring botanists, only belongs to that tiny part of the globe where civilization has become more perfect, and where, as a result, the population has most increased. In countries bordering the equator, man is too weak to subdue a vegetation which hides the soil from view and leaves no gap from the ocean to the rivers. Nature wears a savage and majestic visage which dissolves any immediate cultural efforts.

The origin, the native land, of those plants which are useful to man and which have followed him since the remotest past, is as much an unfathomable secret as is the first home of all our domesticated animals. We are ignorant of the native land of those grasses which form the principal nourishment for the Mongol and Caucasian races; we do not know which region spontaneously produced the cereals: wheat, barley, oats, and rye. This last grass seems not to have been cultivated even by the Romans. Claims to have discovered barley on the banks of the Samara in Tartary, Triticum spelta in Armenia, rye in Crete, wheat at Baschiros in Asia, all growing wild, have not been substantiated, since it is quite easy to mistake those plants escaped from man's dominion and returned to their former liberty for plants spontaneously produced by nature. Birds can easily disseminate cereals in the woods by devouring the seeds. Those plants which comprise the natural wealth of all tropical habitats--the banana, Carica papaya, Jatropha manihot[25], and corn have never been found growing wild. I found several roots of them on the banks of the Cassiquiare and the Rio Negro. However, the savage of those areas, as gloomy as he is suspicious, cultivates small plots in solitary locations; he then abandons them shortly afterwards, and those plants remaining rapidly appear natural to the soil which supports them. The potato, an amiable plant largely responsible for sustaining the populations of the most sterile European nations, offers the same phenomenon as does the banana, corn, and wheat. Regardless of the field investigations I was able to conduct, I never found any traveller who had discovered the potato growing wild, either on the summit of the Peruvian Cordilleras or in the realm of New Spain[26], where it is cultivated with Chenopodium quinoa.

Such relationships doubtless demonstrate the breadth of inquiry which I have tried to delineate within this science. However, any man sensitive to nature's bounty will find yet more: the explanation of the influence that the appearance of vegetation exerts on peoples' taste and imagination. Such a man would take pleasure in examining what is commonly called the character of the vegetation, and the variety of sensations it produces in the soul of the beholder. These considerations are that much more important as they treat intimately of the means by which the imitative arts and descriptive poetry are able to inspire us. The simple aspect of nature, the view of fields and woods, delights in a way fundamentally different from that delight acheived through the particular study of the structure of organisms. In the latter, detail interests and excites our curiosity; in the former, the aggregate stirs our imagination. What are the different impressions caused by the appearance of a vast prairie bordered by a few groves of trees and the vista of a thick and dark mixed forest of oaks and evergreens? What a striking contrast exists between the temperate zone forests, and those of the equatorial zone, where the naked, slender palm trunks rise above flowering mahogany trees and form majestic porticos in the sky. What is the moral cause of such sensations? Are they produced by nature, by massive grandeur, the contour of forms, or the habit of plant life? How does this habit, this view of nature more or less rich, more or less laughing, influence the morals, and especially the sensitivity of peoples? In what does the character of tropical vegetation consist? What physiognomic differences distinguish African plants from those of the New World? What analogy of form unites Andean alpine plant species and those of the higher summits of the Pyreness? Such are the questions, scarcely discussed to date, which doubtless deserve the attention of doctors.

Among the diverse types of plants which blanket the skin of our planet, we can easily distinguish a few general forms to which most species can be reduced, and which contain between them as many families or groups more or less analogous. I shall confine my list to fifteen of those groups, the physiognomies of which offer an important study to the landscape painter:

1. Scitaminales (genera: Musca, Heliconia, and Strelitzia),
2. palm trees,
3. tree ferns,
4. the form shown by the genera Arum, Pothos, and Dracontium,
5. the evergreens (genera: Taxus, Pinus),
6. all maple leaves,
7. the genus Tamarindus (also the genera Mimosa, Gleditschia, and Porlieria),
8. Malvaceae (genera: Sterculia, Hibiscus, Ochroma, and Cavanillesia),
9. tropical creepers (genera: Vitis, Paullinia),
10. orchids (genera: Epidendrum, Serapias),
11. cacti,
12. the genera Casuarina, Equisetum,
13. Gramineae,
14. the mosses, and
15. finally, the lichens.

Those physiognomic divisions have nearly nothing in common with divisions made to date by botanists following quite different principles. In the former we are concerned only with the large contours which determine the physiognomy of vegetation and with the analogous impression granted to those who contemplate nature, while descriptive botany associates plants according to the tiniest, but most essential, parts of fructification. To study the physiognomy of the groups of plants that I have enumerated, not in conservatories and botanical treatises, but in nature itself, would be the worthy endeavor of a distinguished artist. What more interesting subject for a painting than the ancient trunk of a palm tree balancing its varicolored leaves above a group of Heliconia and banana trees? What more picturesque contrast could there be than a tree fern surrounded by Mexican oaks?

Within the absolute beauty of form, with the harmony and the contrast which is born from their union, is to be found that which is called the natural character of this or that region. Some of the most beautiful forms (that of the Scitaminales, palm trees and bamboos) are entirely absent in temperate zones; others, for example the trees with needle shaped leaves, are quite rare and less elegant in temperate zones. Arborescent species are much less elegant in temperate zones. Arborescent species are much less abundant, smaller, and bear fewer of those flowers which delight the eye. Additionally, the frequency of those social plants spoken of earlier and of the practices of cultivation, confer a more monotonous appearance to the terrain of temperate zones. However, in the tropics nature is delighted to bring together all forms. The pines seem to lack at first glance; but in the Andes of Quindiu, in the temperate forests of Oxa and Mexico, there are cypress, firs, and junipers.

In general, plant forms near the equator are more majestic and more imposing; the gloss of the leaves is more brilliant, the parenchyma tissue is more lax, more succulent. The tallest trees are constantly adorned with the most beautiful flowers, larger and more fragrant than those herbaceous plants of the temperate zones. The burnt bark of their ancient trunks forms a most pleasant contrast to the younger foliage composed of tropical creepers, Pothos, and especially orchids, the flowers of which imitate the form and plumage of the birds that suck their nectar. However, the tropics never present the visual expanse of green prairies which border the rivers of northern countries; equatorial inhabitants are almost completely unacquainted with that sweet feeling of vegetation awakened by spring. Nature, charitable to all beings, set aside particular gifts for each region. Fibrous tissue more or less lax, plant colors more or less bright, according to the chemical mix of elements and the stimulating force of the sun's rays: such are a few of the causes which impart a particular character to the vegetation of each global zone. The great elevation of lands near the equator presents a curious phenomenon to tropical residents: their plants have forms identical to European plants.

The Andean valleys are adorned with banana and palm trees; that charitable tree whose bark is the quickest and most wholesome cure for fever is found at higher elevations. Oaks, firs, Berberis, Alnus, Rubus, and a multitude of other genera commonly believed to belong strictly to northern lands are found in the temperate region occupied by the genus Quinquinas and higher in the region occupied by the genus Escallonia. In addition, equatorial inhabitants are familiar with all the vegetative forms which nature disposed around them: the earth unfolds a visual display as varied as the sky's azure vault, which can hide none of its constellations there.

The European peoples do not enjoy the same advantage. The love of sciences or a refined luxury encourages the cultivation of languishing plants in hot-house conservatories where they display a shadow of the majesty of equatorial species. Many forms will stay forever unknown, but the wealth and perfection of language, the imagination and the sensitivity of poets and painters may provide some compensation. The imitative arts allow us to depict the variable pageant of equatorial life. In Europe, an isolated man on an arid shore can derive mental satisfaction from the vista of remote regions; if his soul is sensitive to works of art, if his cultured mind is broad enough to embrace the more diffuse and general considerations of natural sciences, then from the depths of his solitude and without leaving his study, he may abstract all that dauntless naturalists have discovered from the atmosphere to the oceans, penetrating subterranean grottoes or climbing icy summits. It is thus, doubtless, that the light of civilization is most influential upon our individual happiness: we are enabled to live simultaneously in the present and the past, while around us are assembled all that nature can produce in each of the diverse climates; we can communicate with all the peoples of the earth. Supported by discoveries already made, we may leap into the future, and, able to predict consequences of individual phenomena, so to settle forever those laws to which nature is subject. In the midst of such research we have prepared for ourselves an intellectual delight and a moral liberty which will fortify us against the winds of fate; no outside power may hinder our quest.

Humboldt's additions:
I. While using several measures made by Spanish geometers in this work, the author made use of a reduction in the Castillean vara[27] in meters and in fathoms[28] which is not regorous enough. The vara is to the toise[29] :: 0.513074:1.196307, and instead of reducing by 2.3, we must suppose a fathom = 2.3316 varas. Don Jorge Juan only allowed 2.32. However, consider the excellent work by Gabriel Ciscar, _Sobra los neuvos pesos y medidas decimales_, 1800. The beautiful maps _Deposito hydrografico_ of Madrid designate Chimborazo as 7496 varas, which figure should be only 3217 fathoms, or the same number published by Bouguer in _La figure de la terre_. The peak S. Elie is 6507 varas, or 2792 fathoms (5441 meters). The peak Beau-Temps is 5368 varas, or 2304 fathoms (4489 meters). See _Viaje al Estrecho de Fuca Hecho por las Goletas Sutil y Mexicana_, 1792; p. CXX, CXV.

II. At the Philadelphia Society in 1800, Mr. Barton read an essay on plant geography of the United States which has not yet been printed, but which contains some most interesting ideas. He has observed that _Mitchella repens_ is the most widespread plant in North America. It occupies all the land surface from 28 to 69 1/2 degrees north latitude. Likewise _Arbutus uva ursi_[30] extends from New Jersey to 72 degrees north latitude where it was observed by Mr. Hearne. However, _Gordonia Francklini_[31] and _Kionaea muscipula_ are found isolated in small plots. Mr. Barton remarks that in general the same plant species advance farther northward in provinces to the west of the Alleghenies than in provinces to the east, where the climate is colder. Cotton is cultivated in Tennessee at a latitude where it may not be found in North Carolina. The eastern shores of the Hudson Bay are destitute of vegetation, while the western shores are covered. Mr. Barton observes that:

	Western side of the Alleghenies	Eastern side of the Alleghenies
Aesculus flava is found from	36 degrees latitude	to 42 degrees latitude
Juglans nigra	41	41
Aristolochia sypho	38	41
Nelumbium luteum	40	44
Gleditsia triacanthos	38	41
Gleditsia monosperma[32]	36	39
Glycine frutescens[33]	36	40

Even the genus *Crotalus* (rattlesnake) is found up to 44 degrees north latitude east of the Alleghenies, while it advances northward west of the Alleghenies to 47 degrees north latitude. Compare also the excellent work by Mr. Volney on the soil and climate of the United States.

Notes:

1. Augustin Pyramus de Candolle. Both Augustin (in 1820) and his son Alphonse (in 1855), contributed important works to the study of plant georgraphy.
2. Humboldt's note: "Read to the class of physical sciences and mathematics of the National Institute, the 17th Nivose, 13th year." (Translator: January 7, 1805.)
3. *Pyrus aria*.
4. *Leianthus longifolius*.
5. *Corynephorous canesens*.
6. *Julocroton argenteus*.
7. *Ipomoea Pes-caprae*.
8. *Hypericum Brathys*.
9. *Karatas Plumieri*.
10. *Pachira*.
11. Until 1850, New Mexico was a Spanish province roughly comprising Arizona, New Mexico, Utah, Colorado, and Nevada.
12. Mexico.
13. *Taxodium distichum*.
14. *Arbutus menziesii*.
15. *Calluna vulgaris*.
16. probably *Icmadophila ericetorum*.
17. *Stipa*.
18. *Baccharis*.
19. *Dombeya*.
20. probably *Mycoblastus sanguinarius*.
21. probably *Lecidea limitata*.

22. Stellaria media.
23. Cundinamarca.
24. Karaman.
25. Manihot utilissima.
26. Colombia.
27. Any of various Spanish and Portuguese units of length equal to between 31 and 34 inches.
28. Usually accepted as six feet; also variable between 5 and 5½ feet.
29. French unit of length equal to 6.396 feet.
30. Arctostaphylos uva-ursi.
31. Gordonia pubescens.
32. Gleditsia aquatica.
33. Wistaria frutescens.

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